

What is claimed is:

1. A method for forming an ultra fine contact hole in a semiconductor device with use of a KrF light source, the method comprising:
  - 5 forming a KrF photoresist pattern on an insulation layer disposed on a semiconductor substrate, the KrF photoresist pattern exposing a predetermined region of the insulation layer for forming a contact hole in the insulation layer;  
forming a chemically swelling process (CSP) by depositing a chemical material-containing layer that is reactive to the KrF photoresist pattern on an entire  
10 surface of the photoresist pattern and insulating layer;  
forming a chemical material-containing pattern encompassing the KrF photoresist pattern by reacting the chemical material-containing layer with the KrF photoresist pattern through the chemically swelling process to decrease a critical dimension of the contact hole;  
15 rinsing the semiconductor substrate; and  
increasing a thickness of a sidewall of the chemical material-containing pattern to a predetermined thickness by performing a resist flow process (RFP) that makes the chemical material-containing pattern flowed to decrease the critical dimension (CD) of the contact hole.  
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2. The method as recited in claim 1, wherein the CSP chemical material-containing layer has a resist composition comprising de-ionized (DI) water, a cross-linker, a solvent and a photo acid generator (PAG), wherein the DI water constitutes about 90% of the above composition while the remaining components  
25 constitute about 10% thereof.
3. The method as recited in claim 1, wherein the CSP chemical material-containing layer has a thickness ranging from about 1000 Å to about 3000 Å.
- 30 4. The method as recited in claim 1, wherein the CSP is carried out by employing a series of processes including a heat process, a photo-exposure process and an electron beam exposure process.

5. The method as recited in claim 4, wherein the heat process is carried out at a temperature ranging from about 90 °C to about 130 °C.

6. The method as recited in claim 4, wherein the photo-exposure process  
5 uses photo-exposure energy ranging of above about 20 mJ/cm<sup>2</sup> to about 30 mJ/cm<sup>2</sup> in case of using the KrF light source.

7. The method as recited in claim 1, wherein at the step of rinsing the semiconductor substrate, DI water is used to rinse the semiconductor substrate.